VOL. I. NO. 6.

THE
Sidereal Messenger.

Conducted by Wm. W PAYNE,

Director of Carleton College Observatory.

OCTOBER, 1882.

CONTENTS:

"The voice that rolls the stars along
Speaks all the promises."

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NORTHFIELD, MINN.
CARLETON COLLEGE OBSERVATORY.
1882.

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The Sidereal Messenger.

"In the present small treatise I set forth some matters of interest to all observers of natural phenomena to look at and consider."—GALILEO, *Sidereus Nuncius*, 1610.

VOL. 1. OCTOBER, 1882. No. 6.

SMALL PLANETARY NUBULAE.

DISCOVERED AT THE HARVARD COLLEGE OBSERVATORY.

The name of planetary nebulæ was originally used to designate such nebulæ as presented a pretty well defined and nearly circular disk, so that they resembled planets in general appearance. The discovery of Huggins, that these objects are also distinguished from most other nebulæ by their gaseous spectra seems to make it expedient to include in the same class all nebulæ, however small, which have gaseous spectra and an approximately circular form. A very small nebula of this sort is undistingishable from a star in an ordinary eye-piece, but retains its original appearance when viewed through a prism, instead of being distorted like ordinary stars under the same circumstances.

The objects named in the following list have been detected during an extensive examination of the stars with the aid of a direct-vision prism attached to the large equatorial telescope of this observatory. They are mostly undistinguishable from stars when the prism is removed from the eye-piece, but a few of them have small disks. The regions examined have been selected with the view of affording a fair means of learning something with regard to the distribution of these objects in the sky, and it is remarkable that all of those which have been found occur in or near the the Milky Way. This was previously known te be the

case with the larger planetary nebulæ having gaseous spectra.

The observations have all been made by myself, in the intervals of other astronomical work, a definite portion of the sky being usually swept over with the telescope on each occasion.

The sixth object of the list is the Durchmusterung star + 1° 3979. Its brightness and distinct stellar appearance would facilitate micrometric observations, and the study of its possible parallax might therefore be worth undertaking.

No.	Date of Discovery.	R. A., 1880.	Dec., 1880.
1	1880 July 13	18^h 25^m 10^s	−25° 13′
2	July 14	18 4 19	−28 12
3	Sept. 3	18 14 23	−26 53
4	1881 Nov. 25	20 6 27	+37 3
5	1882 July 15	17 58 6	−19 51
6	July 16	19 16 50	+ 1 17
7	Aug. 18	18 7 44	−20 19
8	Aug. 18	17 41 22	−16 26
9	Aug. 18	18 5 13	−19 7
10	Aug. 19	18 56 27	− 0 37
11	Sept. 4	19 28 40	+ 5 26
12	Sept. 17	19 25 36	+ 9 49

Three small nebulæ occurring in Sir John Herschel's General Catalogue or in Dreyer's Supplement to that work, Nos. 4333, 5851, 5942, were encountered during the progress of the work and were found likewise to have gaseous spectra.

EDWARD C. PICKERING.

HARVARD COLLEGE OBSERVATORY,
CAMBRIDGE, U. S., Sept. 9, 1882.

The death of the Swiss astronomer, M. Emile Plantamour was recently announced in this country.

Mr. Plantamour was a native of Geneva. He studied at the University of Konigsburg, Prussia, and obtained the degree of Doctor of Philosophy in 1839. At the Academy of Geneva he was made Professor of Astronomy, and afterward became Director of the Observatory. He was a member of the Society of Physics and Natural History of Geneva, of the Astronomical Society of London, and a corresponding member of the Institute of France since 1865.

THE AUGUST METEORS.

BY DANIEL KIRKWOOD.

Watch was kept for the August meteors at several points in Indiana on the nights of the 8th, 9th, 10th and 11th. At Bloomington, (under the direction of Prof. D. E. Hunter,) Mr. Frank E. Hunter, Miss Omie Sanford, and Misses Mary and Nora Hunter observed continuously for four hours on the night of the 10th. The time of each meteor's appearance was recored by Prof. Hunter, whose note book gives the following results:

From	$10^h\ 30^m$	to	$10^h\ 40^m$	13	meteors.
"	10 40	to	10 50	25	"
"	10 50	to	11 00	12	"
"	11 00	to	11 10	15	"
"	11 10	to	11 20	16	"
"	11 20	to	11 30	23	"
"	11 30	to	11 40	31	"
"	11 40	to	11 50	18	"
"	11 50	to	12 00	14	"
"	12 00	to	12 10	19	"
"	12 10	to	12 20	19	"
"	12 20	to	12 30	24	"
"	12 30	to	12 40	22	"
"	12 40	to	12 50	23	"
"	12 50	to	1 00	28	"
"	1 00	to	1 10	22	"
"	1 10	to	1 20	24	"
"	1 20	to	1 30	17	"
"	1 30	to	1 40	20	"
"	1 40	to	1 50	26	"
"	1 50	to	2 00	36	"
"	2 00	to	2 10	21	"
"	2 10	to	2 20	24	"
"	2 20	to	2 30	29	"

Total in four hours, 521 meteors,

or an average of 130 per hour. Of the whole number, 270 were recorded as conformable to radiants in Perseus or

Cassiopeia, and 50 as unconformable. The radiants of 201 were not determined, though most of the number were doubtless Perseids. 139 were estimated as of the first magnitude, 99 of the second, and 76 of the third. The lengths of the tracks varied from 0° to 25°. A stationary meteor was seen at 1^h 34^m which increased from the fourth to the first magnitude. This, of course, was at the point of divergence and moving directly towards the observers. Its color was white. A bluish Perseid of the first magnitude appeared in Draco at 1^h $33\frac{1}{2}^m$, and moved in a track apparently curved. In a few seconds this was succeeded by another, of nearly the same size and color, which moved in precisely the same path. The meteors frequently came in clusters, five or six sometimes appearing in quick succession. At other times a lull or total cessation would last several minutes.

In one hour—from 8 to 9—on the evening of the 10th, Mr. W. F. L. Sanders, watching alone, at Jasper, Dubois county, counted forty meteors.

At Bloomfield, Greene county, Indiana, the observers on the night of the eighth were Dr. H. R. Lowder, Prof. Poindexter, Ed. Eveleigh, and Christian Danielson, with Samuel Carnahan as clerk. The number observed in six hours—from 9^h p. m. to 3^h a. m.—was 761. On the night of the ninth the observers were H. E. Burnham, D. S. Whitaker, Prof. Minges, and W. L. Cavins, with A. J. Ferris, clerk. In a watch of seven hours, from 9^h p. m. to 4^h a. m., 1527 meteors were counted. On the night of the 10th the observers were Messrs. P. C. Vanslyke, Brantley East, Wm. Wines, J. Furguson, Frank Wilson, Isaac Martin, Otto Herrold, Elmer Harrel, John Knapp, R. T. Thompson, Samuel Carnahan, Grant Armstrong, and John East, with E. E. Cavins as clerk. The number counted in seven hours, beginning at 9^h p. m., was 3677. The maximum was about 3 o'clock on the morning of the 11th, when 235 meteors were seen in 15 minutes. On the night of the eleventh watch was kept from 9^h p. m. to 2^h a. m. by Dr. Lowder, Prof. Poindexter, and Messrs. Burnham, Sergeant and Martin. The number of meteors seen was 667. The

whole number counted, therefore, in four nights by the Bloomfield observers was 6632. In 1839 Heis alone saw 160 in one hour. The shower of that year was one of the most brilliant of the century. It hardly equaled, however, that of 1882.

It was shown in the Popular Science Monthly for February, 1881 that three distinct meteoric swarms move in the track of Tempel's comet. (1866 I.) A comparison of dates seems also to indicate the existence of clusters in the August ring derived from the third comet of 1862. Oppolzer assigns this comet a period of 123 years--in all probability a close approximation to the true value, though possibly two or three years in error. Now, the interval between the Perseid showers of 830 and 1798--the most abundant on record--is equal to eight periods of 121 years. Again, the, the showers of 811, 933, and 1789 correspond to a period of 122 years. So also do those of 841 and 1451. The fact, moreover, that the horary number of meteors was on the same night considerably greater at Bloomfield than at Bloomington, only thirty miles distant, seems to indicate the existence of parallel veins or clusters in the Perseid stream.

TRANSIT OF VENUS.*

BY PROF. WM. HARKNESS, U. S. NAVAL OBSERVATORY.

(Abstract.)

Transits of Venus usually occur in pairs, the two transits of a pair being separated by only eight years, but between the nearest transits of consecutive pairs more than a century elapses. We are now on the eve of the second transit of a pair, after which none other will occur till the 21st century of our era has dawned upon the earth and the June flowers are blooming in 2,004. When the last transit occurred the intellectual world was awakening from the

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* Read by Professor Eastman before the August meeting of the A. A. A. S., at Montreal.

slumber of ages and the wondrous scientific activity which had led to the present advanced knowledge was beginning. What the next transit will find it is impossible to conjecture. Upon the establishment of the Copernican theory it was perceived that transits of the inferior planets across the face of the sun must occur, and the recognition of the value of transits of Venus, for determining the solar parallax was not long in following. The idea of utilizing such transits was first worked out completely by Halley in 1716, and his efforts were mainly instrumental in inducing the governments of Europe to undertake the observations of the transits of Venus in 1761, and 1769, from which the first accurate knowledge of the sun's distance was obtained. Kepler's Rudolphine tables furnished the means of predicting the places of the planets with some approach to accuracy, and in 1627 he announced that Mercury would cross the face of the sun on November 7, 1631, and Venus on December 6 of the same year. Gassendi prepared to observe these transits under great difficulties owing to the want of proper instruments. His observations were taken in Paris. By admitting the solar rays into a darkened room through a small round hole an image of the sun 9 or 10 inches in diameter was obtained upon a white screen. For the measurment of position angles a carefully divided circle was traced upon this screen, and the whole was so arranged that the circle could be made to coincide accurately with the image of the sun. To determine the times of ingress and egress an assistant was stationed outside with a large quadrant and he was instructed to observe the altitude of the sun whenever Gassendi stamped upon the floor. On the 7th of November, a little before eight o'clock, the sun began to struggle through the clouds, and towards nine became distinctly visible. Turning to its image on the screen the astronomer observed a small black spot upon it not half as large as he expected, and he could not believe that it was Mercury. All doubt soon vanished, however, and it was recognized that the transit so patiently watched for was in progress. After his success in observing Mecury, Gassendi hoped he might be equally successful in observing the tran-

sit of Venus on December 6th, 1631. But he was doomed to disappointment. A severe storm of wind and rain, prevailed on December 4th and 5th, and although the sun was visible at intervals on the 6th and 7th, not a trace of the planet could be seen. We now know that the transit happened in the night between the 6th and 7th, and was wholly invisible at Paris. Transits of Venus can occur only in June, and December and as the two transits of a pair always happen in the same month if we start from a June transit, the intervals between consecutive transits will be eight years, 105½ years, 8 years, 121½ years, 8 years, 105½ years and so on. These intervals may be modified, and may be 129½, 105½, 8, 129½ years and so on: or 113½, 8, 121½ 113½ years, etc.; or 8, 113½, 121½, 8 years etc.; or 8, 105½ 129½, 8 years, etc.; or 113½, 129½, 113½, 129½ years, etc., according as the planet's path varies. Jeremiah Horrocks was the next examiner in 1639, and he, with his friend William Crabtree, had the good fortune to witness the first recorded transit of Venus. About 15 minutes past three he found Venus upon the sun's disk, the second contact having just happened. He then made determinations of the position of Venus, which are even yet of the highest importance. The transit of 1761 drew on, and Halley's experiments in 1716 were not forgotten. Delisle was the first to point out the exact conditions of the transit, and the circumstances upon which the success of the observations would depend. Briefly, Halley's method consisted in observing the duration of a transit at two or more stations, so selected as to give durations of widely different lengths, while Delisle's method consisted in employing a common standard time to note the instant when the transit begins or ends, at two or more stations so chosen as to give very different values for that instant. The transit of 1761 was visible throughout Europe, and was well observed by astronomers in all parts of the continent. No less than 117 stations were occupied by 176 observers, and of these 137 published their observations. The results were not satisfactory; values of the solar parallax were obtained, ranging from 8.49 seconds to 10.10 seconds, and it was concluded that too much reliance

had been placed on Delisle's method. The transit of 1769 approached, and attention was directed to Halley's method. The result was better than in 1761, but still not satisfactory: the black drop and other distortions disturbed the contacts in this transit, as they had done in the previous one, and the value of the parallax, deduced by the best computers, ranged from 8.43 seconds to 8.85 seconds. Encke published in 1825 abstracts of this discussion of the transits of 1761 and 1769, from which he deduced a parallax of 8.58 seconds and afterwards modified it to 8.57 seconds. This was accepted for more than a quarter of a century. But experiments led to a strong suspicion that the sun's distance had been overestimated by at least three million miles and the observations of its opposition in 1862 converted the suspicion into a conviction. The 18th century transits were again discussed, and a parallax of 8.83 seconds was found from them by Poulkova in 1865, and 8.91 seconds by Mr. E. J. Stone in 1868. Various other estimates were made before the trnnsit of 1874. Great preparations were made for this event, and the Americans and Europeans got ready (very different) apparatus for photographing the transit. Nearly every civilized government took part, and the weather was fine, but the contact observations were found to be little better than those of the 17th century. The resulting parallax depended to some extent on the computer's guess-work. The British photographs were admitted to be a failure. The Americans had a photographic image of the sun 4.4 inches in diameter. A mistake in using too large a microscope being corrected, those pictures taken between second and third contact showing the sun were of great value. Before the correction was made the European astronomers in congress at Paris, to prepare for the 1882 transit, declared photography a failure. The Americans, all the same, put most of their trust in photography. Exaggerated ideas prevailed that the sun's distance could be settled by transits of Venus alone, but this is not so. However, the real reason for spending so much on transits of Venus is that they are so rare that it would be unpardonable to neglect any opportunity of observing them.

THE EVOLUTION OF THE EARTH.*

SAMUEL HOUGHTON, D. D., DUBLIN, IRELAND.

(Abstract.)

"I entirely concur in Mr. Darwin's published calculations, though I differ from the physical conceptions he started from. The 18th century astronomers believed in the perpetual motion of the planetary system, but 19th century astronomers have discovered that the planets and stars are composed of matter similar to that of our earth, and that perpetual motion is as impossible amongst the planetary bodies as it is on the surface of the earth. It has been tacitly assumed, even so far back as the times of Newton and Clairaut, that the earth and planets have passed through a liquid condition before assuming the solid condition they now possess. Laplace, in his nebular hypothesis, also assumes the former existence of this liquid condition, and it is openly asserted by all geologists who believe that the earth consists of a solid crust, (more or less thick,) reposing upon a fluid or vicsous nucleus. It has been proved by Sir William Thompson, following out the views of the late Mr. Hopkins, that the present condition of the earth, taken as a whole, is such that it must be regarded as being more rigid than glass or steel. The following considerations show that it may be fairly doubted whether the earth or any other planet ever existed in a fluid condition: (1.) The possibility of the equilibrium of the rings of Saturn, on the supposition that they are either solid or liquid, has been more than doubted, and the most probable hypothesis concerning them is that they consist of swarms of *discrete* meteoric stones—*discrete* meaning that they are separate from each other in space. (2.) It is difficult to understand the specific gravity of Jupiter and the other outer planets on the supposition that they are either solid or liquid for we know of no substance light enough to form them. If the outer planets consist of *discrete* meteoric stones, moving around

*Substance of paper read before the A. A. A. S. at its Montreal meeting.

a solid or liquid nucleus, the difficulty respecting their specific gravity would disappear. (3.) The recent researches connecting the periodic showers of shooting stars with comets, tend in the direction of showing that comets, in cooling, break up into *discrete* solid particles, and that probably the solar nebula cooled in like manner into separate fiery tears which soon modified by radiation into the cold of space. (4.) Mr. Huggin's recent comparisons of the spectroscopic appearances of comets and incandescent portions of meteoric stones, showing the presence in both of hydrogen and nitrogen compounds, confirming the conclusions drawn from the identity of the path of comets and meteoric shooting stars. (5.) Mr. W. H. Newton, in 1879, showed the possibility of the aster oids being extinct comets captured and brought into the solar system by the attraction of some one or other of the outer large planets, and permanently confined in the space between Mars and Jupiter, which is the only prison cell in the solar system large enough to hold such disorderly wanderers. From all these, and other considerations, it is allowable to suppose that the earth and moon, when they separated from the solar nebula, did so as a swarm of solid meteoric stones, each of them having the temperature of interstellar space, that is something not much warmer than 460° F. below the freezing point of water. Mr. George H. Darwin has shown admirably how the earth-moon system may have been developed from the time when the earth-moon formed one planet revolving on its axis in a few hours, to the present time, when the earth and moon (in consequence of tidal friction) have pushed each other asunder to a distance of sixty times the radius of the earth. In his paper on the tidal friction of a planet, Mr. Darwin has formed a remarkable equation of conditions. (Dr. Haughton here gave on the blackboard several algebraic calculations, from which he deduced the conclusion that Mr. Darwin's expression was not peculiar to his special hypothesis of a viscous earth, but could be deduced equally well from the totally distinct hypothesis of an absolutely rigid earth retarded by the tidal action of a liquid ocean.) I was led by this result to consider the case

of the earth-moon departing (as I firmly believe they did) from the central solar mass in the form of a swarm of *discrete* masses of meteoric iron and stone, each one having the temperature of the intense cold of interstellar space. I entirely disagree, therefore with Sir William Thompson and others in thinking that this earth and moon was once liquid and cooled in passing through a stage of viscosity into the present condition. Mr. Darwin has taken that idea of the earth and moon and has applied his analysis to discover the laws of the earth-moon evolution in the supposition that the moon acts upon the earth by producing tides in the viscous earth in which he obtained two remarkable equations. (Dr. Haughton represented them on the blackboard). But this remarkable result does not prove any one of the theories of friction that have been supposed. It only shows—what I would not like to say before the general public—how little, after all, mathematicians know. In section A, of course, we know a great deal more than the other sections, and if the public admits this, we may have the modesty to confess that there are depths in the ocean that our sounding line does not reach. Thirty years ago I paid great attention to a particular theory of light, and I published several papers upon it in which I gave the mathematical public a choice of six theories, each one of which would account for the whole phenomena. Mathematics cannot decide the important question between viscous earth and a cool earth of meteoric stones. Sir William Thompson tried to prove mathematically that one hundred million years ago the earth was as hot as melted steel, and he ordered the geologists to hurry up with their phenomena. My opinion is that we take the ground from under their feet by showing that the earth may have been composed from the very beginning of meteoric stones, all of them very cold or not of much heat. Sir Wm. Thompson drew great comfort from the phenomena of volcanoes. But a volcano is only a pustule on the surface of the earth, and a surgeon who opens a boil on your arm might as well come to the conclusion that the whole body was one vast abscess. Sir Wm. Thompsan, who imagines the earth to

have been fluid from the phenomena of volcanoes, with all his ability, is as bad as the surgeon who declares the whole body putrid from the existence of a boil on the arm."

HINTS ON OBSERVING METEORS.

E. F. SAWYER.

(Continued from page 94.)

II. To note and reduce shower meteors to their radiant points is a task of little difficulty to an observer already conversant with the position of the principal fixed stars and constellations. The use of star charts for projecting meteor paths soon familiarizes even unpractical observers with all preliminary preparation for this kind of interesting astronomical work. Facility is also soon acquired in fixing on a map the initial and end points of a meteor's track, and in drawing through these points, a straight line backwards to show the common crossing point of many such lines which is called the radiant of meteors belonging to one shower. The impressions of direction by the eye alone in tracing the meteor's track among the stars are of uncertain use in fixing the radiant point correctly. A straight wand brought into line to assist the eye will rudely show this. If we apply to the picture of the stars before the eye, the simple principles of plane projection, commonly used in drawing easy pictures of objects, the straight wand and the straight path of the meteor in the sky are also straight lines when drawn on the map, and these lines may be prolonged on the map with greater ease and more certainty than is probable if the attention of the observer is directed only to the meteoric streak in the sky.

When the paths of a considerable number of meteors are thus projected, they may be easily examined and compared and a radiant point will become more or less apparent according to favoring circumstances of observation.

It is not only important to note the duration of flight of a meteor, but also to record any peculiarities noticed, such as, apparent length of path, brightness, speed, duration of flight, and the presence of sparks or streaks in its track.

These characteristics belong to meteoric showers, and to individual meteors as well, and they form interesting subjects of inquiry.

The observation of sporadic shooting-stars is more difficult and less attractive to ordinary observers than is that of meteors belonging either to the well-known major and "special," or to some minor annual showers. The mode of work, however, is the same, although more protracted watching is maintained, in general, for one or more whole nights by a single observer, to obtain a successful collection of meteoric tracks.

III. Bolides, fire-balls and large meteors present phenomena that are easily seen and usually widely observed. On this account observations of these classes of bodies give definite results, not gained in the study of poor and scanty showers. Although it is true that each observer will see the track of a near fire-ball in a different part of the sky from every other observer, this apparent disagreement largely or wholly disappears when these individual observations are properly projected. If special care is taken in locating the path by the stars, or in any other certain way, by two independent observers, these apparent paths, if produced backward to their intersection, will be sufficient to determine the direction, and the real course of a bright meteor or a fire-ball. But a dozen meteors of a poor and scanty star-shower only afford presumptive evidence of a radiant point at the center of divergance. To be sure of a common system of sporadic shooting-stars observations must be greatly multiplied. If two or more simultaneous observations of the bright meteor or fire-ball could be taken accurately, the height, velocity, and even the orbit of the body would be known as certainly as the orbit of a meteor stream. But such accuracy of observation as would allow us to depend upon two observations only, is seldom, if ever, reached by observers, either of shooting-stars or fire-balls; and of the latter especially, many accounts are annually given by unpracticed observers, containing no material data of the meteors' courses while the discordant notes occasionally furnished of shooting-stars by skilled observers

show the difficulty, if not the hopelessness, of arriving by two observations at anything approaching the accuracy of instrumental determinations. With rare exceptions, therefore a large collection of observations is useful for exact comparisons, which it is the object of the Luminous Meteor Committee appointed for this purpose by the British Association to obtain, by providing observers with suitable forms of registry, maps and instructions for recording the appearances of fire-balls and ordinary shooting-stars. The committee distributes to observers who apply for them printed forms of Registry and Directions, as the most convenient and efficient means of assisting them in systematic observations."

NUMBER OF METEOR STREAMS.

Up to the present time the radiant points of same two or three hundred independent meteor systems have been determined with greater or less accuracy, the majority, however representing very feeble systems, and many of them may yet be shown to be the outlaying members of more active streams, or from the inaccurate determination of the radiant points to represent *pseudo* meteor showers.

A SCHEME FOR OBSERVING THE SOLAR ECLIPSE OF MAY, 1883.

The following is a summary of a paper prepared by Mr. C. H. Rockwell, New York, and read at the meeting of the American association. The great astronomical event for 1883 will be the solar eclipse to occur on the sixth day of May. At the points of greatest obscuration the totality will last nearly six minutes. Unfortunately the line of totality is almost exclusively a water track running from a point about 200 miles back of the east coast of Australia, going north-easterly to nine degrees south latitude, 130 degrees west longitude, thence toward the coast of South America, terminating about 500 miles from the coast.

The only island crossed by this line is a small coral reef called "Caroline Island;" this was discovered by Captain Nares, the Artic explorer, in 1874, who gave its length at nine miles and width at one mile.

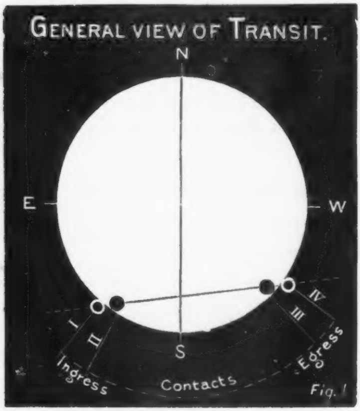
This point is in ten degrees south latitude, 140 degrees west longitude, and is probably the only point where the eclipse could be observed. To reach this island a schooner or steamer would have to be chartered especially for the voyage; the expense of such a vessel suitable for the purpose would be about $6,000.

TRANSIT OF VENUS.

DECEMBER 6, 1882.

Work for surveyors and civil engineers with the transit and level at ingress and egress and on the horizon and meridian of railway and telegraph stations of diverse altitudes above the sea.

Name of Railway.	APPROXIMATE POSITIONS. NAME OF STATION.	Latitude North ° ′ ″	LONG. WEST OF Greenwich ° ′ ″	LONG. WEST OF Wash. h m s	Alt'de above Sea	APPROX. TIME OF II. Contact at Ingress.	APPROX. TIME OF III. Contact at Egress.
						h m	h m
Atchison, Topeka and Sante Fe Railroad.	Topeka	39 3	95 39	1 14 24	......	8 2.3 A.M	1 25.9 P.M
	Newton	38 4	97 15	1 20 48	......	7 54.0 "	1 19.6 "
	Ellinwood	38 22	98 31	1 25 52	......	7 50.8 "	1 14.6 "
	Dodge City	37 39	100 8	1 32 20	2482	7 44.5 "	1 9.0 "
	La Junta	37 58 54	103 32 45.	1 45 58	6612	7 30.7 "	0 54.8 "
	Trinidad	37 10 46.5	104 30 1.4	1 49 50	5590	7 26.8 "	0 51.0 "
	Las Vegas	35 35 27.6	105 13 27.6	1 52 42	6418	7 23.8 "	0 48.3 "
	Sante Fe	35 41 19.3	105 56 45 2	1 55 35	7044	7 20.9 "	0 45.8 "
	Albuquerque	35 2	106 40	1 57 48	4918	7 18.6 "	0 43.5 "
	Soccorre	34 10	106 48	1 59 0	4659	7 17.5 "	0 42.3 "
	San Marcial	33 42	107 8	1 59 48	4447	7 16.6 "	0 41.6 "
	Deming	32 46	108 10	2 4 28	6318	7 11.3 "	0 36.7 "
Southern Pacific.	Tucson	32 14	110 56	2 15 32	2537	7 1.1 "	0 26.3 "
	Yuma	32 43 30	114 38	2 30 20	......	Bel. Hor.	0 11.4 "
	St Diego	32 44	117 08	2 40 20	67	"	0.02.0 "
	Los Angeles	34 3	118 16	2 44 52	318	"	11 57.5 A M
	Goshen	36 10	119 25	2 49 28	......	"	11 55.4 "
	San Francisco	37 48	122 26 15	3 1 33	60	"	11 41.0 "
Union Pacific.	Omaha	41 15	96 3	1 16 0	......	8 00.8 A.M	1 24.1 P.M
	Kearney	40 38 30	98 57 30	1 27 38	......	7 49.2 "	1 12.9 "
	North Platte	41 8	100 53	1 35 20	2838	7 41.5 "	1 05.3 "
	Julesburg	40 59 7.6	102 21 32.3	1 41 14	3500	7 35.5 "	0 59.3 "
	Cheyenne	41 7 46.6	104 48 51.3	1 51 3	6041	7 25.7 "	0 49.7 "
	Rawlins	41 48 50	107 14	2 0 44	......	7 16.0 "	0 40.5 "
	Creston	41 43 34	107 43	2 2 40	......	7 14.0 "	0 38.6 "
	Green River	41 31 38	109 28 6.5	2 9 41	6140	Bel. Hor.	0 31.6 "
	Evanston	41 22	110 54	2 15 24	......	"	0 26.0 "
	Ogden	41 13 8.5	111 59 54.6	2 19 48	4374	"	0 21.6 "
Central Pacific.	Elko	40 49 38.4	115 45 37.2	2 34 51	5148	"	0 06.7 "
	Carlin	40 42 26.6	116 7 20.6	2 36 17	4908	"	0 05.6 "
	Winnemucca	40 58 20	117 43 54.1	2 42 44	1355	"	11 59.5 A M
	Reno	39 36	120 58	2 55 40	4484	"	11 46.6 "
	Sacramento	38 35	121 31	2 58 52	76	"	11 44.2 "
Northern Pacific.	Duluth	46 48	92 8	1 0 20	700	8 16.9 A M	1 39.7 P.M
	Brainerd	46 20	94 13	1 8 40	......	8 8.3 "	1 31.4 "
	Glyndon	46 53	96 39	1 14 24	......	7 59. "	1 21.8 "
	Bismark	46 48	100 38	1 34 20	1677	7 43. "	1 05.1 "
	Fort Keogh	46 20	105 58	1 55 40	......	7 21. "	0 45.1 "
	Bozeman	45 40 52	111 2 36.6	2 15 58	4838	Bel. Hor.	0 25.3 "
	Wallula	46 3	118 40	2 46 28	......	"	11 55.[illegible] A M
	Kalama	46 1	123 53	3 7 40	......	"	11 34.6 "
	Takoma	47 21 30	122 4	3 0 4	......	"	11 42.1 "
Ore. & Calif.	Portland	45 30 24	122 27 30	3 1 38	96	"	11 40.8 "
	Roseburg	43 10	12[illegible] 16	3 4 52	537	"	11 37.6 "
	Shasta	40 30	122 17	3 0 56	......	"	11 41.7 "
Misc'laneous.	Denver	39 44	105 4	1 52 4	5196	7 24.5 A M	0 49.7 P.M
	Pike's Peak	38 48	104 59	1 52 42	14[illegible]36	7 24.6 "	0 49.1 "
	Prescott, Arizona	34 29 6	112 30 30	2 21 50	5316	6 54. "	0 20.0 "
	Boise City	43 40	116 6	2 34 12	2877	Bel. Hor.	0 09.6 "
	Sitka, Alaska	57 3	135 18	3 53 0	......	"	10 49.8 A M
	Unalashka, Alaska	53 25	166 49	5 59 4	......	"	8 41.7 "
	Nunivock Island	60 00	167	6	......	"	Sunrise.

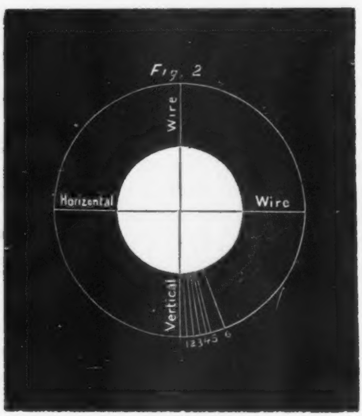


When to begin and where to look for the first notch in the sun's lower limb with reference to the wires of the telescope, of transit or level when the sun is in the middle of the field of view as in figure 2.

1. Duluth, N. P. R. R., at 7:53 a. m.
2. Fargo, N. P. R. R. at sunrise.
3. Omaha, U. P. R. R., at 7:47 a. m
4. Topeka, A. T. & St. Fe., at 7:38 a. m.
5. Julesburg, U. P. R. R., at sunrise.
6. San Marcial, N. M., at sunrise.

At all other places on previous list east of Fargo, Julesburg and San Marcial, the first notch may become visible within the above limits (1 to 6) about 22 minutes before the end of ingress or the time of the second contact

FIRST CONTACT ON THE HORIZON.



Places where ingress may begin while the sun is passing through the telescope of a level set up in a position where the field of view of the levelled telescope will clear the visible horizon from about S. 55° E., to S. 65° E.

1. Santa Fe, Albuquerque, Soccowo, San Marcial, Deming, on A. T. & Santa Fe R. R.

2. Big Springs, Barton, Julesburg, Chappel, Sidney on U. Pacific R. R.

3. Morehead, Fargo, Cassleton, Wheatland on Northern Pacific R. R.

SECOND CONTACT ON HORIZON.

Place where ingress may end in a level telescope, and where the phenomenon of the "Black drop" and other distortions may become most conspicuous.

1. Tucson, Red Rock, Casa Grande, Maricopa, Gila Bend, Yuma on the Southern Pacific R. R.

2. Fort Steele, Rawlins, Summit, Separation, on Union Pacific R. R.

3. South Heart, Houston, Fogarty, Sully Springs, Little Mission on Northern Pacific R. R.

THIRD CONTACT ON THE MERIDIAN.

Places where egress may begin while the sun is passing through the telescope of a transit instrument *adjusted to the meridian.*

1. Fresna, Madera, Merced, Gressey, Salida on Southern Pacific R. R.

2. Granite Point, White Plains, Hot Springs, Wadsworth Central Pacific R. R.

3. Umatilla, Celilo, Rockland on Northern Pacific R. R

A few examples of supposed observations desirable to be made at all stations.

On horizonwire of level, vertical wire of transit.	SANTA FE.		RAWLINS.	
	Level.	Transit.	Level.	Transit
First limb of sun.......	6h 55m 17s A	11h 50m 12s A	7h 12m 51s AM	11h 50m 13s AM
First limb of Venus....		11 50 37	7 15 58	11 50 32
Second limb of Venus..		11 50 41	7 16 4	11 50 36
Second limb of sun....	6 58 15	11 52 33	7 16 6	11 52 34
First contact	6 58 15	6 58 33		6 54 34
Second contact		7 20 35	7 16 6	7 16 34
Third contact		0 45 33 P		0 40 34 PM
Fourth contact		1 7 33		1 02 34

On horizon wire of level vertical wire of transit.	SAN FRANCISCO.		REMARKS.
	Level.	Transit.	
First limb of sun......	7h 0m 36s A M	11h 50m 14s A M	
First limb of Venus....	7 3 18	11 50 22	
Second limb of Venus..	7 3 24	11 50 24	
Second limb of sun....	7 3 44	11 52 34	
First contact..........			
Second contact........			
Third contact		11 41	
Fourth contact........		1 03 P M	

At the risk of being considered presumptuous, I venture to offer a few suggestions concerning the manner in which

our engineers, esspecially those located along the lines of the Pacific railways might make themselves useful to the astronomers of the world on the occasion of the approaching transit of Venus. While the means of observation at the command of the average engineer may be wholly inadequate for all the rigorous requirements of the astronomer, they may nevertheless be used to good advantage in obtaining important data worthy the astronomers' consideration.

At all events if for nothing more than an experiment in a practical effort to bring the noble problem of the solar parallax nearer home to the average understanding, the common engineers' transit and level, by the aid of which many an obstacle in the way of progress has been overcome, and many a chasm bridged, should not be considered too insignificant for an attack on the chasm between earth and sun by the familiar base line method.

In this case we cannot actually measure a base line, set up our transit at each end and observe the angles between base and sun as in triangulating over a river, but we can do our share of the work at one end and compare it with the work of other observers in various parts of the world, and select a number of suitable bases the lengths of which can be calculated from the known dimensions of our earth.

To use a homely illustration of what is wanted let the right eye represent a point in the United States, and the left eye a point on Cape Horn, a thumb held out at arm's length Venus, and a window ten feet distant the sun. Alternately closing one eye and looking with the other we shall see our thumb projected upon the window in different places. Thus when the transit of Venus begins in the United States it has already begun at Cape Horn, in Europe and in Africa, and observers there will see Venus some distance from the edge of the sun. And when the transit ends in the United States it has not yet ended at Cape Hern, New Zealand and Australia. There the planet is still some distance from the edge of the sun and will have to move through a certain portion of its orbit requiring a proportional interval of time before it reaches the edge of the sun to an observer in these parts of the earth.

Now it is this difference in the position of Venus, while projected as a small black disc upon the edges and upon the disc of the sun during the transit as seen from different parts of the earth at the same time which is wanted, and which will give us another base line upon the sun proportional to the base on our earth in the ratio of the distances between earth and Venus, Venus and sun, and the ratio of these distances being known from the motions of Venus and earth in their orbits, the actual distances in miles can readily be calculated from the actual length of the base line on our earth, and having found the distance between earth and sun we can easily obtain the angle substituted by the radius of our earth at the distance which is the solar parallax.

In its general features this great problem on which the mind of man has labored from the earliest dawn of history until now, appears to be simple and easy enough, yet it is not so easy to obtain observations absolutely free of error which is practically impossible, and the principal part of the work therefore, consists in clearing the observed displacements of the planet upon the sun of the various instrumental errors, and of the effects of atmospheric refraction varying with the altitude of a body above the horizon, with the moisture, temperature and pressure of the air, consequently with the elevation of an observer above the sea. This is one of the most intricate and important elements entering into the astronomer's calculations, hence all data throwing any light on this subject will be valuable, and here seems to me to be the engineers' special work on this occasion.

The different methods of observation also play a prominent part, and it is an open question which will yield the most reliable results.

Celestial photography having been brought to great perfection in this country, our American astronomers will prefer this method to all others, and determine the desired differences in the position of Venus upon the sun by a comparison of the photographs taken in the United States with those taken at Cape Horn and other South American stations.

The English and French astronomers while not wholly discarding photography, will principally rely upon contact observations at Greenwich and Paris, the Cape of Good Hope, the Bermudas, Florida, the West Indies, the Argentine Republic, New Zealand and Australia; while the Germans will measure the desired distances between Venus and the sun's limbs directly with the heliometer at their home observatories, and their temporary stations on the Atlantic coast of the United States, at Bahia and on the straits of Magellan.

But what can the engineer do with his small transit and level and common watch and without subsidies?

In view of the elaborate and complete arrangements of the astronomers under the auspices of the various governments of the world, any private effort on the part of engineers would indeed seem utterly useless and absurd, yet their brethren of the 21st century would certainly not forgive them should they neglect so rare an opportunity, denied to two whole generations after this, to contribute a mite to the general fund of the world's knowledge on this interesting occasion.

While in the nature of the case all attempts on the part of the engineer, to establish the absolute times of the beginning or end of the transit, or either, at his respective station may be hopeless, he can nevertheless furnish many valuable data for determining effects of refraction and explaining attending phenomena, such as the so-called "black drop" which in former transits have bothered the astroners so much and rendered their work uncertain, leaving the distance between earth and sun, the great standard unit of all other distances beyond the moon, in doubt by several millions of miles.

Those parts of the United States therefore where the coming transit begins on or near the horizon and ends on or near the meridian, and which afford the greatest variety of elevations above sea level from the continental divide down to the Pacific coast, and which as far as I now know have been wholly neglected in the programme of the astronomers seem to me the special field of labor reserved for the

engineer for observations of the short intervals of time between the passages of the preceding and following limbs of sun and planet over the horizontal wire of the Level telescope and over the vertical wire of the Transit telescope and the instants of contacts.

The level of course will not be available unless set up in a position where the field of view of the levelled telescope will clear the visible horizon at the point of sunrise which will be from about South 55° to 65° East, and the eye must be protected against the glare of the sun in some way, either by colored spectacles or a piece of dark glass fixed inside the cap over the eye-piece of the telescope.

The transit begins at or shortly after sunrise along the line of the Atchison, Topeka & Santa Fe railway from Trinidad to Deming, on the Union Pacific R. R. at or near Julesburg and on the Northern Pacific R. R. at or near Fargo. There the effects of refraction will be greatest rendering contact observations extremely uncertain, while they will be least at Rio de Janeiro and other South American stations where the transit begins when the sun is near the zenith.

At the numerous well equipped observatories in Germany, Austria, Hungary and Western Russia, Greece, Italy, Spain and Portugal, Norway and Sweden, England, France and Switzerland, Egypt and all Africa the transit begins on the setting sun on or near the horizon and there the effects of refraction will be still greater than here because European observers will see the I and II contacts through an atmosphere on which the sun has shone all day, while we see them through an atmosphere cooled off during the night.

At some point between Fresno and Salida on the Southern Pacific R. R., between Granite Point and Wadsworth on the Central Pacific, Umatilla and Rockland in Oregon the transit will end that is the III or internal contact at Egress will occur on the meridian, while in Alaska and Australia it will happen on or near the horizon at sunrise.

Thus it will be be seen, that the weather permitting, there will be no lack of corresponding observations under

similar and under different conditions with which the herein proposed observations may be compared.

Lines between points in the United States and in Europe will be nearly parallel with, while lines between North and South American stations will be nearly perpendicular to the path of Venus across the sun, the former chiefly affecting the right ascension, the latter the declination of Venus upon the sun' and either affording measures of the relative parallax of Venus from which the solar parallax may be deduced as shown before.

These short intervals of time to be observed elapsing between the passages of the preceeding and following lines of sun and planet, over the horizontal wire of the level telescope at sunrise, and over the vertical wire of the transit telescope at apparent noon and intermediate times, and between contacts will not be fatally affected by slight instrumental errors of any kind, because all will be affected alike, and will serve to locate Venus upon the disc of the sun at any desired time during the transit corresponding to the time of some other observation in South America, Europe, Africa, New Zealand or Australia, and to the student of astronomy at least, if not to the professional astronomer, it will be interesting to see what results may be obtained from the proposed observations.

It seems to me very desirable, therefore, that every available transit instrument, anywhere in the United States, and every level at, and west of the above named stations on the Pacific railways should be employed as suggested on the 6th of December next. Meanwhile the many large sunspots visible every month, will afford an excellent opportunity to practice the proposed observations.

For any further details I must refer the reader who may contemplate to engage in this work, to the forthcoming instructions for observing the transit, to be issued by the superintendent of our naval observatory at Washington, a copy of which, I presume, may be had by any one interested in the subject on application to some member of congress or directly to the superintendent of the naval observatory.

As far as my personal efforts are concerned, I hope to observe the transit at some point in southern New Mexico, or Arizona, where the chances of good weather are the most propitious, and I am happy to say that through the courtesy of Mr. C. C. Wheeler, general manager, and of Mr. A. A. Robinson, chief engineer of the Atchison, Topeka & Santa Fe R. R., the co-operation of all the resident engineers of that railway line, at least have been secured, stations greatly differing in elevation above the sea will probably be occupiedby efficient transit and level parties, and it is hoped that other stations on the other lines will also be heard from. And thus an earnest attempt at least will be made to test the efficiency of the herein outlined engineers' method of solving the noble problem of the solar parallax.

F. Hess.

Fort Dodge, Iowa, Sept. 18, 1882.

DISTANCES OF THE STARS.

A good illustration is sometimes a positive gift to science —witness the *demons* of Prof. Clark Maxwell.

In a recent lecture by Dr. William Huggins, on the results of spectrum analysis as applied to the heavenly bodies, this striking statement was used to give some faint notion of the enormous distance of the stars. "The earth's orbit," said the lecturer, "which is more than 190,000,000 miles in diameter, at most of the stars dwindles to a mere point, and has no sensible size whatever. If you suppose a railway from the earth to the nearest fixed star, which is supposed to be twenty billions of miles from us; and if you suppose the price of the fare to be one penny for every hundred miles—not, mind! a penny per mile—then, if you take a mass of gold to the ticket office equal to the national debt ($3,800,000,000) it would not be sufficient to pay for a ticket to the nearest fixed star. And I think I should not be wrong in saying that there are stars so far off that, at the price of one penny for every hundred miles, the whole treasure of the earth would not be sufficient to pay for a ticket."

EDITORIAL NOTES.

The thirty-first annual meeting of the American Association for the Advancement of Science was held, at Montreal, during the last week of August according to general announcement. The attendance was large, numbering in membership about nine hundred and twenty, which was but little less than the register at the great meeting in Boston two years ago.

The welcome of the city of Montreal to the Association was cordial and generous, the courtesies of prominent citizens of the place greatly varied, thoughtful and attractive, and, in general, the local arrangements were ample and very complete, reflecting credit on the management of Dr. T. Sterry Hunt, who was officially responsible for this important part of the programme.

Dr. J. W. Dawson of McGill University, Montreal, was President of the Association, and occupied the chair during most of the general sessions.

The papers and discussions on themes belonging to astronomy given in different sections of the Association will receive attention, from time to time, as space offers opportunity.

Prof. William Harkness of Washington, D. C., Vice President of the Association, and presiding officer for the section of mathematics and astronomy, chose for the subject of his annual address, *The Transit of Venus*. In his absence, the paper was presented by Professor J. R. Eastman of the Naval Observatory.

It contained a clear and full statement of what is important in the history of all former transits of this planet, the theory and use of the transit to astronomy, and something concerning the comparative value of different methods of observing it. The paper was so complete and useful at this time, that it is greatly to be regretted that a full copy of it could not be obtained in time for publication. An imperfect abstract is given elsewhere.

Most of the following themes were presented during the week:

Parallax of *a Lyrae* and 61 *Cygui* by Professor Hall. (Read by Professor Eastman.)

Description of the new 23 inch equatorial, recently erected in Halstead observatory, at Princeton, N. J., by Prof. C. A. Young.

A correction to Newton's Principia in regard to the time of approach of two spheres, by Prof. De Volson Wood.

Some suggestions on the nature of comets, in connection with recent astronomical and electrical discoveries by P. H. Vander Weyde.

New views of Mr. Geo. H. Darwin's theory of the evolution of the earth-moon system, by Dr. Samuel Houghton of Dublin, Ireland. (Abstract elsewhere.)

A new method of eliminating the personal equation in transit observations, by J. B. Webb.

Conservation of solar energy by P. E. Chase.

A scheme for observing the great eclipse of May 1883, by Charles H. Rockwell.

Determination of the relation;—Metre de Archives=Imperial Yard, +3.37015 inches, W. A. Rogers.

The color of the sun by S. P. Langley. (Owing to the absence of its author the paper was not read.)

Standard Time for North America, by Winslow Upton.

On the performance of a new form of astronomical level, Wm. A. Rogers.

On a method of reducing different Catalogues of Stars to a homogeneous system, Wm. A. Rogers.

On international standard time. E. B. Elliot.

A study of the the problem of fine rulings with reference to the limit of naked-eye visibility and microscopic resolution, Wm. A. Rogers.

A bell attachment for telescope circles, H. M. Parkhurst.

Arrangements have been made by which most of the foregoing papers will be secured for publication from month to month, thus giving a brief account of the freshest thought and the varied work now going on in astronomy.

The next annual meeting of this Association will be held in the city of Minneapolis, during the third week of August 1883. Professor C. A. Young of Princeton College, N. J. was elected President of the general Association for the ensuing year.

The late report of Professor G. W. HOUGH of Dearborn observatory Chicago, is a document of unusual interest to astronomy.

While under the direction of Professor Hough, the work of the great equatorial has been mostly confined to the study of special objects and phenomena, for which great optical power and good definition are desirable.

The following objects have received special attention:

1. The Great Comet of 1881.
2. The planet Jupiter.
3. The satellites of Uranus.
4. Difficult double-stars.

In 1881, between June 23 and July 14, Professors Hough and Colbert, on eight different nights made micrometric measures and sketches of the nucleus and envelope of the great comet showing the changes that took place from day to day. It will be remembered that Professors Stone and Wilson of Cincinnati claim that they saw on the evening of July 6, at 11h. 30m, M. T., a distinct division of the nucleus into two parts, nearly equal in size, and that these parts were, by micrometric measure, distant from each other fully 6" of arc. Their observations of this strange phenomenon were continued for several hours and during which full notes and careful sketches were made. Neither of the Chicago observers saw the division. Prof. Hough in his late report says: "If such a division really took place it must have continued

only a few hours. It seems possible, therefore, that the phenomenon in question was simply occasioned by the want of sufficient optical power to see the real character."

It is true that the separation continued only for a short time, and it is possible that two experienced and careful observers, as the Cincinnati men are, should be mistaken, but it does not seem to us at all *probable*.

The Cincinnati glass has an aperture of 11¼ inches. Since it was refigured by the Clarks in 1876, it has excellent definition. It does not seem possible that such a glass would fail in optical power to show six seconds of arc faithfully in a comet's nucleus.

The work on the planet *Jupiter* during the last three oppositions has enabled Professor Hough to decide definitely on some points regarding the phenomena exhibited on his disc

He is sure that direct micrometric measurement is greatly superior to any other method of estimation, in determining markings on the planet's surface. The changes now taking place on the surface are slow and gradual, a fact which is directly contrary to the teaching in text-books, and the history of astronomy. Though the actual condition of the surface can not yet be fully ascertained Professor Hough thinks that the phenomena seen on the disc will be found to be periodical in a manner analogous to that exhibited on the surface of the sun. He believes the markings are comparatively permanent in locality, and that the surface of the planet is liquid, or in a plastic condition. The observations of 1879 and 1880 showed that the great red spot was retrograding with an accelerated velocity. This drifting has continued to the present time with remarkable uniformity.

From the observations of two years past it appears that the apparent rotation-period has increased about four seconds, indicating a total drift of the red spot in longitude 40,000 miles; about 10,000 miles the first year, and 30,000 during the second. From these observations it is plain that the red spot is not a solid portion of the planet, as has been held by a number of astronomers. One of the curious features of this spot is its stability. It is thought to be an immense floating island 29,600 miles long by 8,300 miles in width; and it has maintained its shape and size without material change during more than three years.

The mean rotation-period of the planet as deduced from the observation of this spot between Sept. 25, 1879 and March 29, 1882, comprising 916 days or 2,214 rotations of the planet is $9^h\ 55^m\ 35.9^s$. This result is identical with one of the results obtained by astronomer Schmidt of Athens, Greece, in the discussion of observations of this spot extending over the year 1879 and 1880. Professor Schmidt, however, claims that $9^h\ 55^m\ 34^s.4$ is the more probable rotation-period for the planet, as determined at that time.

Professor Hough's observations and discussions respecting the belts

and the white spots are exceedingly interesting, because they bear directly on the rotation-time of different portions of the surface, as well as on its condition. Some eight small oval white spots were observed in 1880. They were not fixed among themselves, or with reference to the great red spot; yet, they indicated about the same time of rotation. Two white spots south of the red spot were systematically observed for a period of three months, from Nov. 21, 1881 to Feb. 23, 1882. The observations of one of the spots show that it was at rest for fourteen days, and that subsequently it began to drift in the direction of the planet's rotation, and in two and a half months the total drift was 41°. During the last two months the average drift was at the rate of fifteen miles per hour. The two white spots did not retain the same relative position in longitude.

"The observations of the small white spots during 1880 and 1881," Professor Hough thinks, "prove that the whole surface of the planet outside the margin of the equatorial belt rotates with nearly the same rate. Also that these minute spots are not absolutely fixed in longitude, but may have a slow direct or retrograde motion. They are *not*, therefore, the tops of mountains as a recent writer has suggested."

The observation of certain equatorial white spots show also a drift in the direction of the planet's rotation, at the rate of two hundred and sixty miles per hour, themselves making a complete revolution on the planet's surface in about forty-five days.

Professor Hough's report contains ten drawings of Jupiter made to accompany the above observations; also two fine cuts representing the interior of the dome of the great equatorial, and the exterior of the observatory building.

The new heliometer of Yale college observatory which is already mounted, is said to be one of the most perfect instruments of its kind in the world.

The great comet of 1882 which should be designated comet *b* for the year; has been the late important theme among astronomers everywhere. It is not yet certain where, or by whom, it was first seen. One dispatch states that a brilliant comet was seen in Panama, Sept. 6, and afterwards; another, that Mr. Cruls of Rio Janeiro saw a large, bright comet on Sept. 10. Although neither of these observers gave a definite place for the object seen, it is very probable that both observations refer to this same comet. So far as known this celestial visitor was first seen in northern latitudes at Washington Sept. 19. Immediately after obtaining these observations, Professors Frisby and Skinner of the Naval observatory gave themselves to the task of computing an approximate orbit, and the results of their work are shown in the following circular communicated by the superintendent of the U. S. Naval observatory Washington, D. C.

Elements of great comet from observation on Sept. 19.1, 19.9 and 20.9 made at the U. S. Naval Observatory.

$$T = \text{Sept. } 16.9836 \text{ Wash. M. T.}$$
$$\pi = 57^\circ\ 23'\ 8''$$
$$\Omega = 346^\circ\ 26'\ 41''$$
$$i = 142^\circ\ 11'\ 40''$$
$$\omega = 70^\circ\ 56'\ 26''.$$
$$\log q = 7.9395.$$

O–C

Agreement of middle place $\begin{cases} \lambda = -11''. \\ \beta = -11''. \end{cases}$

OBSERVATIONS.

Sept, 19.1	$2^h\ 45^m\ 45^s.7$ Wash. M. T.	$11^h\ 19^m\ 39^s.8$	$+0^\circ\ 7'\ 34''$.
19.9	on meridian	$11\ 14^m\ 17^s.94$	$-0^\circ\ 34'\ 28.5''$.
20.9	on meridian	$11^h\ 9^m\ 10^s.97$	$-1^\circ\ 19'\ 21.1''$.
23.	$18^h\ 19^m\ 35^s$ Wash. M. T.	$10^h\ 38^m\ 12.^s$	$-3^\circ\ 9'\ 54''$.

The elements were computed by Messrs Frisby and Skinner.

EPHEMERIS COMPUTED BY PROF. FRISBY.

	α			δ			lg △	lg r	$\frac{1}{\delta \Delta^2}$
Sept. 10.5	9^h	56^m	10^s	$-$	0°	$48'.1$	0.8330	9.5827	0.221
12.5	10	20	13	$-$	0	27 .8	0.0138	9.4771	0.392
20.5	11	3	20	$\pm$	3	14 .9	0.0745	9.5744	0.250
26.5	10	50	44	$-$	4	40 .0	0.0982	9.6777	1.105
30.5	10	41	47		6	48 .0	0.1144	9.7547	0.060
Oct. 4.5	10	34	25		8	41 .4	0.1275	9.8250	0.040
8.5	10	23	3		10	31 .0	0.1333	9.8920	0.028
12.5	10	22	22		12	15 .6	0.1437	9.9529	0.022
16.5	10	16	33		13	52 .6	0.1532	6.9986	0.017
20.5	10	11	23		15	32 .5	0.1584	0.0531	0.014
24.5	10	8	16	$-$	17	3 .2	0.1612	0.0785	0.013

$$x = r\,[9.99558]\ \text{Sin}\,(171^\circ\ 43'\ 32'' + v).$$
$$y = r\,[9.98796]\ \text{Sin}\,(263^\circ\ 42'\ 42'' + v).$$
$$z = r\,[9.43629]\ \text{Sin}\,(\ 50^\circ\ 58'\ \ 0'' + v).$$

The argument of the ephemeris of the comet is in Geenwich mean time.

The brightness of the comet at the time of the observation of Sept 19.1 was assumed as the unit.

U. S. NAVAL OBSERVATORY, Sept. 26, 1882.

These elements are very surprising in that they agree so closely with those of the Great Southern comet of 1880. Some leading American astronomers have already expressed the belief that this comet is identical with that of 1880, which was the notable one of 1843.

If this be true, the last short period of less than three years offers to astronomers a most interesting question to solve, viz: How is its period made suddenly so short? The following important information respecting this comet is just received from Professor YOUNG:

OBSERVATIONS OF THE COMET OF SEPT. 18TH, AT PRINCETON, N. J.

The news of the comet was first received with the morning papers on Tuesday the 19th. Fog and clouds prevented observation until near noon, when the comet suddenly became easily visible to the naked eye, and was observed for nearly two hours with the 23 inch equatorial of the Halsted observatory. Unfortunately it was not found quite early enough to permit of its observation with the meridian circle of the School of Science observatory, half a mile away.

The glare of the sun upon the object glass of the great equatorial was such that nothing could be seen of the comet in that telescope except its nucleus. There was no difficulty, however, in pointing upon it with the micrometer wire, and seven observations were made of its declination, and as many of right ascension, together with a number of pointings upon α Virginis to determine the instrumental corrections. As the instrument is very stable the readings of the 30 inch circles ought to give pretty accurate results. Clouds interrupted the observations of the star, however, before they were satisfactorily completed, so that the absolute places are probably less accurate relatively than the hourly motion.

On Wednesday only one observation in declination was obtained, with two in right ascension, and these between clouds. The comet could not be seen with the naked eye. No star pointings could be got, and in reducing the observations I have used therefore the index corrections deduced the day before.

Since Wednesday it has been continuously cloudy.

The positions obtained were as follows:

1882, Sept. 19, $0^h\ 30^m$ Pr. M. T., $\alpha\ 11^h\ 20^m\ 19.^s2 \pm 0.^s5$.
" " " " ", $\delta + 0^\circ\ 12'\ 07'' \pm 5''$.

Hourly motion in R. A. $-16.^s3$; in Dec. $-\ 2'\ 19.''8$.

Sept. 20, $1^h\ 28^m$ Pr. M. T., $\alpha\ 11^h\ 13^m\ 56.^s7 \pm 1^s$.
" " 1 16 " " ", $\delta - 0^\circ\ 38'\ 15'' \pm 10''$.

The observations are corrected for refraction, and instrumental errors, but not for parallax.

On the 19th the comet was beautifully seen in the 5 inch finder, which was screened from the glare by the tube of the great telescope. It presented very closely Brodie's figure of Coggia's comet (of 1874) given as the frontispiece of Chambers' Descriptive Astronomy, 3d edition, though of course the faint outer veilings could not be seen.

The nucleus was diffuse, not stellar, (magnifying power about 75); the first envelope was pretty bright and well defined, extending out on each side to form the tail, and the second envelope was easily visible, though rather faint. The interesting feature, however, was the pair of eccentric arcs connecting the two envelopes: they were not conspicuous, but I think there is no doubt as to their reality.

I did not succeed in getting any spectroscopic observations The glare in the large telescope was too strong

COMET *c* of this year was discovered by E. E. Barnard of Nashville, Tenn., Sept. 14 at three o'clock in the morning, in right ascension 7^h, 17^m, 34^s, and declination north 16° 45′. On the morning of the 15th it had gained in right ascension 1^m, 48^s, and lost in declination 48′. The comet is a telescopic object, quite small, yet distinct enough to be seen easily in Mr. Barnard's five inch telescope. It has a slight central condensation without nucleus or tail. It is traveling in a south-easterly course in the constellation of *Gemini*.

This comet was also observed at four o'clock on the morning of the 19th at the Naval Observatory in Washington. Its right ascension was then 7^h. 27^m; declination 12° 41′ north.

Professor HOLDEN calls attention to a fine red star of the 8—9 mag. in the following position for 1880:

R. A. 18^h 11^m 34^s.

N. P. D. 103° 29′.

It precedes star 33673 by 33″, and is 7′ north of it.

Under date of Aug. 23, Mr. BARNARD of Nashville, reports the finding of a moderate sized nebula, plainly visible α 2^h $57\frac{1}{4}^m$; δ −23° 21′ ± It is closely *s. f.* a small, bright red star. Herschel's III 245, occupies about that place, but the description does not answer, viz: "R. A. 2^h 55^m 3^s, dec. −23° 35′, v F; c L; i fig.; r; unequally B". Surely this nebula must be brighter than when Herschel examined it for it is not at all faint in his 5 inch telescope. We stated in the last MESSENGER (page 135) that Professor SWIFT had examined the new nebula near φ *Virginis*, and found it mottled, indicating resolvability. This is a mistake; that remark was intended to apply to a different nebula.

The annual report of Professor HOLDEN of WASHBURN OBSERVATORY to the Regents of the University of Wisconsin gives the following details in regard to the work of the Washburn Observatory for the year 1881 Sept. 30, to 1882 Sept. 30.

With the large equatorial 95 new double stars have been discovered, since the return of Professor HOLDEN from California where he observed the Transit of Mercury Nov. 7, 1881. Four new nebulæ have also been discovered by Professor HOLDEN as well as a considerable number of red and colored stars.

The reduction of the Zone observations made at the Naval observatory Washington in the years 1846-7-8-9, is well under way. All of the stars are copied [38,346 in all] each on a separate card, and 4592 well determined zero-stars have been accurately reduced to 1850.0 for

comparison. The Mural Zones have been compared with the zero stars as far as 18 hours of R. A.

A system of controlled clocks in Madison has been in operation for some months, and it is likely to be extended.

The Repsold meridian circle is to arrive in October 1882.

The Star YARNALL 3106 was observed six times and is given as 7.8 mag

In the Merid Circle Zones it was observed as follows:

Zone 83 No 145, Feb. 1, 1847, 9—10;

Zone 159 No. 95, Jan 23, 1949, 8;

In the Mural Zones it was observed:

Zone 230, No. 4, Feb. 19, 1849, 10;

Zone 231, No. 55, Feb 23, 1849, 10;

It is not in ARGELANDER's Southern Zones, nor in any of the following catalogues; Bonn Beob. vi, LAMONT, LALANDE Melbourne, Cape '40, cape '60, cape '80, Paramatta. Its place for 1860 is

$7^h\ 31^m\ 27^s$;—31° 1'

It is perhaps worth attention. E. S. H.

A translation of *Sir Wm. Herschel, his life and works* by Professor E. S. HOLDEN has just been published by Wilhelm Hertz of Berlin under the title of *William Herschel; Sein Leben und seine Werke: ubersetzt von* A. V. *Mit einem Vorwort von Prof. Dr.* W. VALENTINER, *Vorstand der grossh. Sternwarte zu Karlsruhe.*

NEW TWELVE-INCH TELESCOPE.

Alvan Clark & Sons are making a twelve-inch equatorial for the observatory of the U. S. Military Academy at West Point E S H.

Star No. 2892 of YARNALL's catalogue is given by him as 4.2 mag. from 5 obs. This star is Lacaille 2647 and is given by BAILY (Lacaille) as 6½; by ARGELANDER (S Z) as 6; 7; 6.7; by SCHMIDT (4 obs) as 6 0 (B. B. vi) by GOULD in *Uran. Arg.* as 6.3; by Stone (Cape catal. 1880) as 7.7. In the Washington Mural Zone 152, it is marked 8 mag. in Mural Zone 94 it is 3 mag. (both Zones by PAGE) and in Transit Zone 210 it is 5.6. The chances are that it is not variable, but perhaps it is worth attention. Its place for 1860 is $7^h\ 4^m\ 42^s$;—27° 16'. E. S. H.

OBSERVATORY AT LIEGE (BELGIUM).

A credit of 96,000 francs ($19200) has been granted by the Chambers of Belgium to found an observatory at the University of Liege. It will be chiefly devoted to the instruction of students in geodesy and geographical surveying. E S H.

VARIABLE STAR

The star D. M + 8°, 4899 was observed by Dr KRUEGER (1853 August 29) as 9 5 magnitude and by Dr SCHOENFELD (1854 Sept 30) as 9.5 mag. and it was not seen by SCHOENFELD in a zone observed 1854, Sept. 16 Dr de BALL calls attention to the fact that on August 13,

1882 it was barely visible in the eleven inch refractor of the Bothkamp Observatory. E S H

TRANSIT OF VENUS, 1882 Dec 6.

The United States will send a party to New Zealand under the charge of Prof H. S. PRITCHETT of Washington University, St Louis, and Mr EDWIN SMITH of the Coast Survey. Mr. Smith had charge of the Chatham Island party in 1874.

Those gentlemen take with them the original KATER pendulum (brought to this country by Major HERSCHEL in 1882) and will swing them at Sydney, Singapore, Hong Kong and Tokio E. S. H.

Attention is called to the new advertisement of Messrs. James W. Queen & Company of Philadelphia This enterprising firm keeps on hand, a large stock of the best mathematical, optical and philosophical instruments, made either in this country or in Europe We notice that the firm is constructing a circular illuminating attachment for the micrometer, also the polarizing solar eye-piece with 2, 3 or 4 reflecting surfaces, and other improved accessories for small instruments. Persons in want of apparatus will do well to correspond with the house.

Several very interesting articles including a brief one signed "B" received from Winthrop. Me are necessarily deferred for want of space. Book notices and considerable late news is put forward for the same reason.

A prominent observer of Cambridgeport Mass reports concerning the August meteors that observations were made on the 9th and the 11th, the night of the 10th b ing overcast. On the 9th from the 11^h to 13^h, 37 meteors were recorded, one being four times as bright as *Jupiter*, and four brighter than first magnitude stars; 27 were *Perseids* and 10 belonged to other radiants. On the 11th from 11^h to 12^h (cloudy afterwards) 18 were recorded, 14 being *Perseids*. It was ceatainly a meager display on the evenings mentioned, the maximum probably oc-occurring on the 10th.

The new variable of the Algot type discovered at this place is proving to be a most interesting object.

At Montreal, we were deeply interested in the exhibition of Prfessor Roland's large gratings ruled in concave surfaces, fully described in the last MESSENGER. Though the weather was unfavorable, a spectrum excellently defined was shown to a few private viewers.

The transit of *Venus* is a theme so important, at this time, that very large space is given to it, even to the disadvantage of variety and brevity. The article by Mr Hess will enlist a large force of observers in the trial of his new plan

Dr C. S Hastings of Johns Hopkins University, Baltimore, recently gave us, in personal interview, a clear and quite full description of the way that he worked out his curves for object-glasses for the telescope.